Successful Transcatheter Bioprosthetic Heart Valve Paravalvular Leak Closure: The Role of 3-dimensional Transesophageal Echocardiography

Dear Editor,

Case Report

Patient

This 60-year-old male had rheumatic mitral valve stenosis treated with open mitral valvotomy in 1982, percutaneous transmitral commissurotomy in 2008 and mitral valve replacement (29 mm EPIC™ bioprosthetic mitral valve) plus tricuspid valve ring annuloplasty in 2009. He remained dyspnoeic after surgery. On auscultation, the pulmonary component of the second heart sound was loud with no obvious mitral regurgitant murmur. Two separate transthoracic echocardiograms failed to demonstrate prosthetic valve dysfunction. However, transmitral gradient was disproportionately high for the prosthetic valve type (6 to 12 mm Hg, depending on heart rate) with exaggerated ventricular interdependence.

Cardiac catheterisation showed severe pulmonary venous hypertension (wedge pressure 28 mmHg , mean pulmonary artery pressure 49 mmHg). Subsequently, transesophageal echocardiography revealed severe, eccentric mitral paravalvular regurgitation (PVR) arising from a 4 mm dehiscence at the lateral aspect of the mitral annulus (Fig. 1A).

Procedure

Under general anaesthesia, a trans-septal puncture was performed to permit left atrial access. Three-dimensional transesophageal echocardiogram (3DTEE) showed a cresentic defect measuring 20 x 6 mm (1.1 cm^2 on planimetry) (Fig. 1B). An 8.5 Fr Agilis NXT™ Medium Curve Steerable Sheath was advanced across the septum with its tip positioned near the defect (Fig. 1C). A 6Fr MPA2 coronary guide catheter was telescoped within the Agilis sheath, following which, a 260 cm stiff Terumo angled glidewire® was used to cross the defect, guided by 3DTEE (Fig. 1D and 1E). The coronary guide was then advanced towards the LV apex over the wire and the Agilis sheath rail-roaded over the guide across the defect. The wire and coronary guide were then removed. A 16 mm Amplatzer® Vascular Plug II was advanced through the Agilis sheath and sandwiched the defect effectively. 3DTEE confirmed device stability and showed reduction in severity of PVR (mild-moderate) (Fig. 1F).

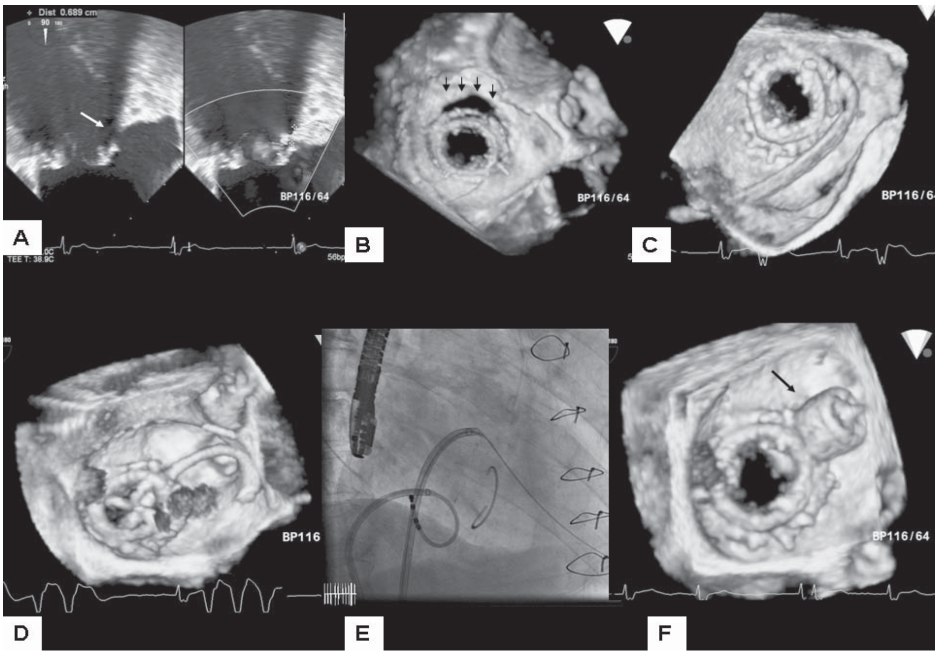

Fig. 1A. Sizing of the paravalvular defect (white arrow) by two-dimensional transesophageal echocardiography (TEE) which measured 4 mm. Fig. 1B. Three-dimensional transesophageal echocardiography (3DTEE) shows a much larger crescentic defect (black arrow heads). Figs. 1C and 1D are 3D TEE images showing devices crossing the defect compared to fluoroscopic imaging (Fig. 1E). Fig. 1F shows effective closure of the defect.

Discussion

Paravalvular leak is defined as abnormal retrograde flow of blood around the circumference of a prosthetic valve between the annulus of the native valve and the sewing ring. The incidence of PVR following surgical implantation of mitral prosthetic valves is estimated at 12.5%.[1] Most occur within a year of surgery and result from detached sutures, degeneration[2] or endocarditis.[3] Clinical presentation depends on the etiology (e.g. infective endocarditis), extent and location of the regurgitation. Severe PVR can cause heart failure while smaller defects may result in haemolytic anaemia. Conventional surgical repair is the gold standard and had previously been advocated for all cases. This is done by direct suture repair of the leak site or replacement of the valve and requires a sternotomy, cardioplegia and cardiopulmonary bypass. Recently, transcatheter device closure is increasingly used in selected patients.[4]

This case highlights several learning points. Firstly, PVR was underappreciated by transthoracic echocardiography due to prosthetic shadowing and the eccentricity of the regurgitant jet. In this patient, the larger defect seen on 3DTEE led to intra-procedural changes in interventional strategy. We now feel that a pre-procedural 3DTEE should be routinely performed to determine technical feasibility, permit appropriate patient counseling with respect to the anticipated success rates and risks, as well as preparation of interventional devices. Secondly, this case illustrates the limitations of fluoroscopy in determining if devices have traversed the paravalvular defect in prosthetic valves with less radio-opaque landmarks, and demonstrates the excellent capability of live 3DTEE in guiding catheter manipulation and positioning. Despite these benefits, there remain some limitations in 3DTEE that are likely to be resolved with improvements in transducer and computing technology in the near future. These include the need for wider-angle acquisitions, improvement in spatial and temporal resolution and the ability to acquire data in a single cardiac cycle. Alternative imaging modalities like intra-cardiac echocardiography (ICE) may allow such procedures to be done without the need for general anaesthesia but 3D capability with ICE is still being developed.

Conclusion

3DTEE contributes to the success of transcatheter paravalvular leak closures. Its routine use should be considered for diagnosis and intra-procedural guidance of transcatheter intervention.

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